

1961

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### Recommended Citation

Bartone, J. C. (1961). The Use of Different Embryos in Studying the Development of Man. *Journal of the Minnesota Academy of Science, Vol. 29 No. 1*, 298-300.

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## ZOOLOGY

### THE USE OF DIFFERENT EMBRYOS IN STUDYING THE DEVELOPMENT OF MAN

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The early development of man (embryology) is generally taught with the use of embryos of different animals. Human embryos are seldom used. This is true in the medical, graduate and undergraduate curricula. The primary reason for this utilitarian approach is simply because human embryos are generally not obtainable in numbers sufficient for the wide distribution necessary for all colleges and universities. Another reason is that fairly good substitutes are available to exhibit the early embryological stages of development of man. Some of these substitutes are embryos of the chick, frog and pig.

The availability and use of chick embryos has been standard in enabling students of embryology to follow specifically the developmental phases from the unincubated egg through the somite stages as represented at the 24-, 33-, 48- and 72-hour levels until the chick reached an age of four days. This embryo of four days is variously equivalent, developmentally, to human embryos from five to eight mm. long. Chick embryos of subsequent age become increasingly avian in appearance and since chick embryos of four days are in a corresponding developmental stage of the youngest pig embryos of six mm. (Arey, 1954), the change is effected to the latter to exemplify continued development of mammalian embryology. Thus a level of parallel development is reached whether one uses four day old chick embryos, six mm. pig embryos or the five to eight mm. human embryos. The study of embryogenesis is further facilitated by utilization of the classic ten mm. pig embryo as a representative study of human embryos ranging from eight to twelve mm. in length.

The ten mm. pig embryo is the ultimate stage studied in most universities because organogenesis is nearly complete, complexity is at a minimum and its microscopic anatomy can be easily worked out by students through the use of serial sections. Some medical schools continue—via lantern slides and demonstrations—to exhibit later and larger stages using human material.

As a rule, the homologous procedure and comparative stages of development of chick, frog and pig, in respect to correlative morphogenesis, is difficult to comprehend and understand. This sub-human and infra-human material is generally used only as an easily acces-

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sible substitute for understanding the development of man. Chick, frog and pig embryology is seldom studied *per se*. However, it is possible to arrange non-human embryos into various and characteristic stages of development to exemplify the different stages of the embryology of man. F. P. Mall (1914) first classified human embryos into selected stages of development. This plan would enable the comparison of embryos of the same stage of development as well as a comparison of the relative development of embryos. Streeter (1942) elaborated the basic plan of Mall (1914). He arranged embryos into groups or periods that could best represent levels of structural organization as a whole. Thus, one may have embryos placed in a series of increasingly complex states of transition by structural arrangements that characterize the periods of development and which may be cataloged from the microscopic one-celled egg to the fetal form. Streeter (1942) qualified the distinctive periods selected into "horizons." Embryonic horizons are levels of development with characteristic features. Streeter (1945-51) also characterized many of the developmental horizons of man until his death in 1948. Heuser and Corner completed the work of Streeter and in addition described Horizon X (1957).

Bartone (1960) has since stated that the Streeter Horizons of Development may be applied for the classification of embryos other than human. Such a procedure would at once keep the continuity of the study and teaching of development smooth and steadily advancing level by level regardless of animal or species. Embryology, medical or biological, could then be taught with more effect, efficiency, and lasting thought when presented as a series of developmental horizons from beginning to end. Embryos, sub-human or infra-human, would then be looked upon as entities which represent classic horizons in studying the development of man.

Toward this objective various embryos are being examined and typed as to the classic human horizons they may portray.

The four day chick embryo attains a developmental state corresponding to some of the youngest mammalian embryos and its classification upon the horizons has been effected (Bartone and Ridenour, 1961). This chick can by its external morphology be compared sufficiently with human horizon XIII. While such comparison cannot be accomplished with totality the evidence reveals correlation of similarity of developmental levels.

Chick embryos in development earlier than four days reveal heterochronous conditions (Ridenour and Bartone, 1961). These comparisons are difficult because of particular limitations: (1) organs of embryos are not always coordinated in exact time patterns or sequence; (2) similar organs or parts of similar embryos do not always develop at the same time; (3) similar structures may not reflect the degree of difference contained within respective embryos. Furthermore, subjective factors are involved in the classification of non-human embryos which are dependent upon the number and importance of selected structures.

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Morphological characters are the most suitable criteria for establishing the developmental stage of an embryo. However, regardless of any particular method of classification, there are inherent limitations of application. Balinsky (1960) has written that the unequal rate of development of various embryonic parts should always be taken into consideration.

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